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Spectrum Engineering (Firm)
Cameron Creek emergency backfill, Golden Valley County, Montana

FINAL REPORT

CAMERON CREEK EMERGENCY BACKFILL
GOLDEN VALLEY COUNTY MONTANA

JANUARY 1988

SPECTRUM ENGINEERING
MINING & CIVIL ENGINEERS

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F I N A L R E P O R T

CAMERON CREEK EMERGENCY BACKFILL
GOLDEN VALLEY COUNTY MONTANA

JANUARY 1988

Prepared for: MR. RICHARD JUNTUNEN, CHIEF
Abandoned Mine Reclamation Bureau
Department of State Lands
1625 11th Avenue
Helena, Montana 59620

Prepared by: SPECTRUM ENGINEERING
Mining & Civil Engineers
3302 Fourth Avenue North
Billings, Montana 59101

William Maehl, P.E.
Donald Sutton, P.E.
Project Engineers

Donald Sutton, P.E.
Project Inspector

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CAMERON CREEK EMERGENCY BACKFILL
F I N A L R E P O R T

I. INTRODUCTION

A. Project Objectives

The CAMERON CREEK emergency backfill reclamation work was undertaken to stabilize a decline adit under the Cameron Creek county road, remove debris from decline entrance, and to investigate the possibility of an another mine working that might be located beneath the road to the north of the adit.

B. Site Description and Location

The CAMERON CREEK site is located approximately 22 miles north of Lavina, Montana. The mine site is located at an elevation of 4300 feet above sea level and drainage is to the southwest to an elevation of 4220 feet at the confluence with Cameron Creek proper. The highest point in the area rises to 4500 feet to form a plateau just north of the project area. The Cameron Creek site is surrounded by dryland wheat fields and natural grazing land consisting of native grasses, cactus and sagebrush.

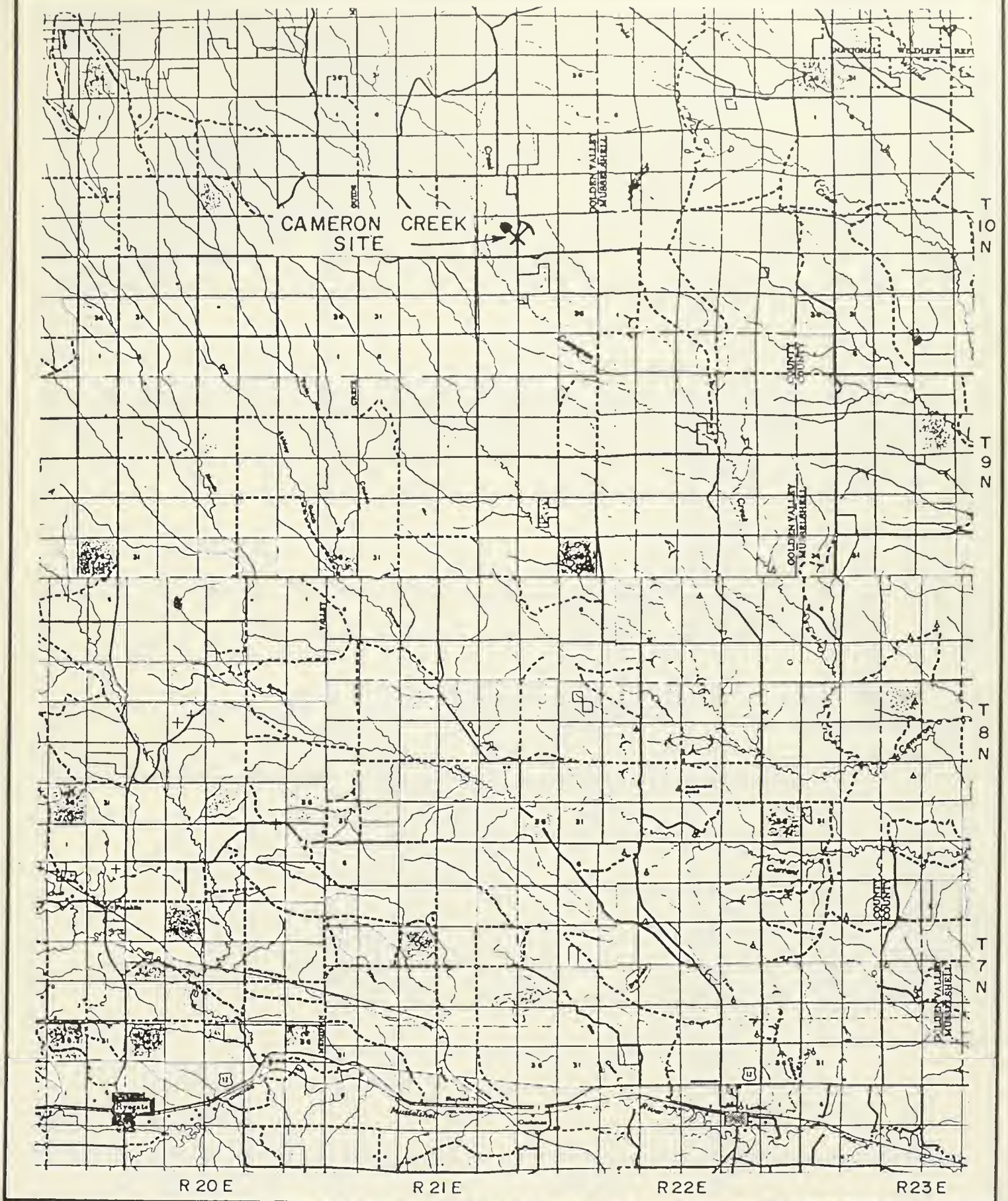
The actual mine location is next to and directly under the Cameron Creek county road which is the north, south line between Sections 22 and 23, more particularly described as the E 1/2 of the SE 1/4, Section 22, Township 10 North, Range 21 East, Golden Valley County, Montana as shown on the Site and Vicinity Maps.

C. Land Ownership and Access

The CAMERON CREEK site is owned by Edgar Lewis, Lavina, Montana 59046 at phone 406/575-4447 or 406/538-8622. The Lewis's have owned the land since the 1940's. They transferred ownership to Lewis Ranch Inc. on 2/22/1967. Mr. Lewis lives 0.5 miles west-southwest of the site on the south line of Section 22.

D. History

The Cameron Creek site is located on a patented homestead entry 016861. The Darrell adit is driven on a 20 degree decline to the east cutting into the coal bed at a depth of 40 feet below the surface. Haulage was maintained by the use of wooden cars and a gasoline hoist. The coal was stored in a wooden bin having a capacity of 60 tons. The mine had been developed by 8/3/1921 as reported in the Bureau of Land Management township and range reports.



STATE OF MONTANA — DEPARTMENT OF STATE LANDS
ABANDONED MINE RECLAMATION BUREAU—RECLAMATION DIVISION

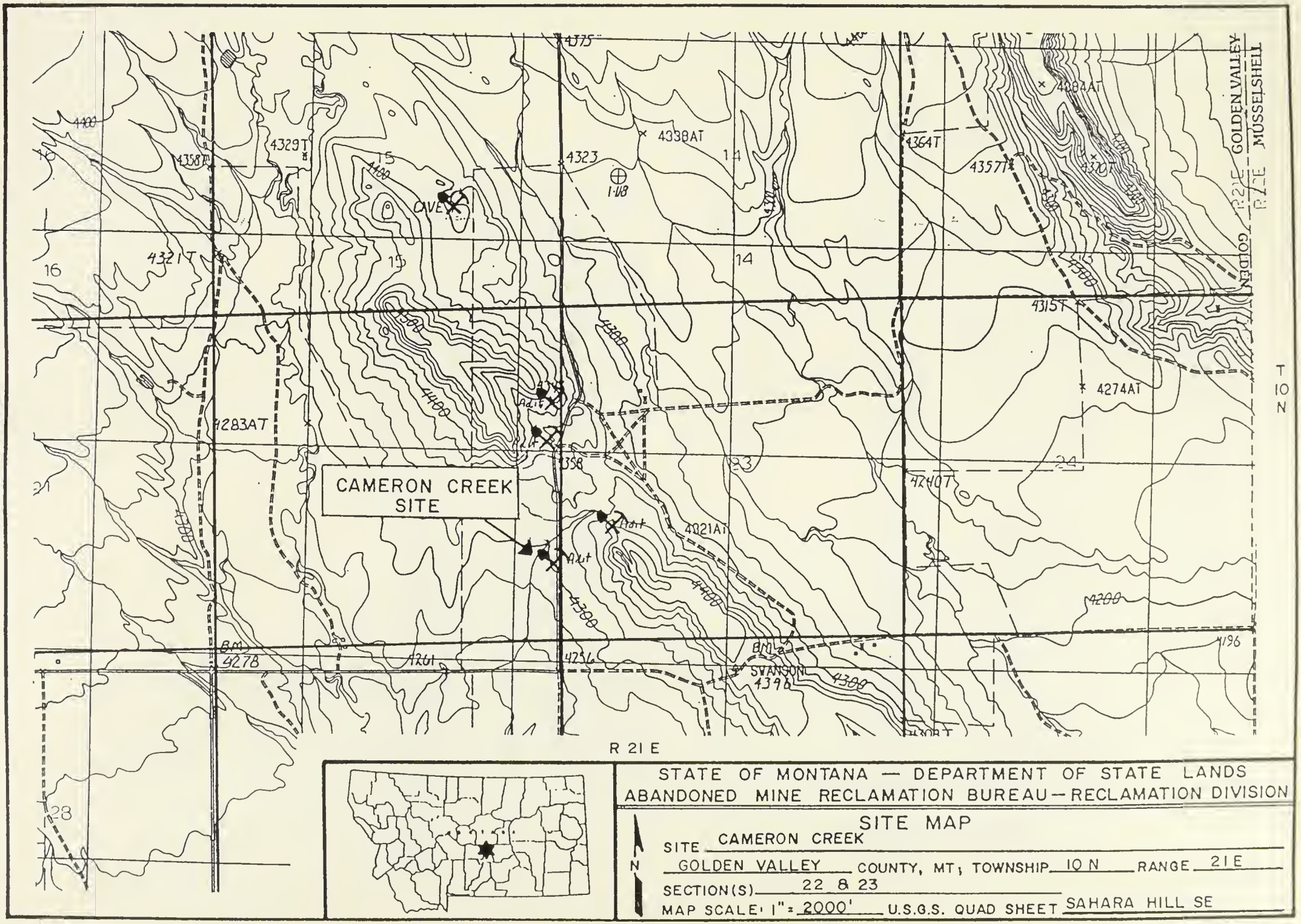
VICINITY MAP

SITE CAMERON CREEK

GOLDEN VALLEY COUNTY, MT; TOWNSHIP 10 N RANGE 21 E

SECTION(S) 22 & 23

MAP SCALE: 1" = 3.5 Miles



STATE OF MONTANA — DEPARTMENT OF STATE LANDS
ABANDONED MINE RECLAMATION BUREAU — RECLAMATION DIVISION

SITE MAP

SITE CAMERON CREEK

GOLDEN VALLEY COUNTY, MT; TOWNSHIP 10 N RANGE 21 E

SECTION(S) 22 & 23

MAP SCALE: 1" = 2000' U.S.G.S. QUAD SHEET SAHARA HILL SE

E. Site Hazards and Problems

A decline adit starts approximately 55 feet west of the Cameron Creek County Road and runs east directly under the road. This project was designated as an emergency due to the potential for collapse of the county road. Up until recently only farm machinery and local residents were using the road. However, heavy logging truck traffic had recently become a common occurrence. These trucks were hauling steadily even during the reclamation construction.

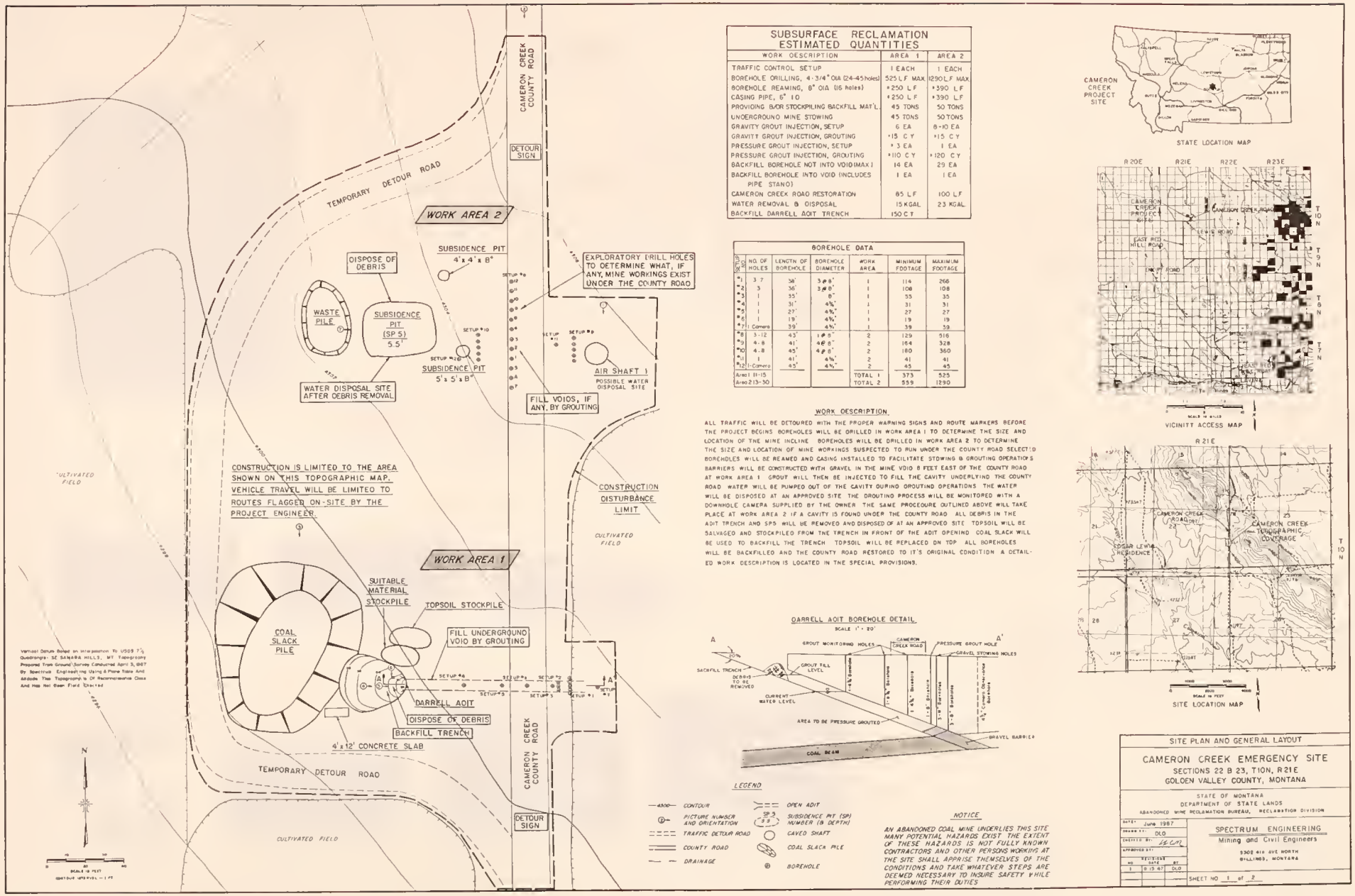
Subsidence features 175 feet to the north of the adit are on both sides of the road, with some being used as garbage dumps. Without underground maps it was impossible to tell but it appeared that the mining may have recrossed under the road.

II. DESCRIPTION OF RECLAMATION PROJECT

A. Project Planning

The major items of work for this project are as follows:

1) Drill boreholes in Area 1 to determine size and location of decline mine adit;
2) Drill boreholes in Area 2 to determine size and location of suspected workings under the county road;
3) Selected boreholes will be reamed, with casing installed to facilitate stowing and grouting operations;
4) Construction of a gravel barrier in the mine void directly east of the county road;
5) Injection of grout in void;
6) Removal of all debris in the adit trench and SP 5;
7) Backfill the adit trench with coal slack, two feet of suitable overburden and one foot of topsoil previously stockpiled to prepare for revegetation; and,
8) Revegetate all disturbed areas.


CAMERON CREEK COUNTY ROAD
DETOUR SIGN
TEMPORARY DETOUR ROAD
WORK AREA 2
SUBSIDENCE PIT 4'x4'x8'
DISPOSE OF DEBRIS
WASTE PILE
SUBSIDENCE PIT (SP 5) 5.5'
SUBSIDENCE PIT 5'x5'x8'
WATER DISPOSAL SITE AFTER DEBRIS REMOVAL
EXPLORATORY DRILL HOLES TO DETERMINE WHAT, IF ANY, MINE WORKINGS EXIST UNDER THE COUNTY ROAD
AIR SHAFT 1
POSSIBLE WATER DISPOSAL SITE
FILL VOIDS, IF ANY, BY GROUTING
CONSTRUCTION IS LIMITED TO THE AREA SHOWN ON THIS TOPOGRAPHIC MAP. VEHICLE TRAVEL WILL BE LIMITED TO ROUTES FLAGGED ON-SITE BY THE PROJECT ENGINEER.
CONSTRUCTION DISTURBANCE LIMIT
CULTIVATED FIELD
WORK AREA 1
SUITABLE MATERIAL STOCKPILE
TOPSOIL STOCKPILE
COAL SLACK PILE
FILL UNDERGROUND VOID BY GROUTING
DARRELL ADIT
DISPOSE OF DEBRIS
BACKFILL TRENCH
4'x12' CONCRETE SLAB
TEMPORARY DETOUR ROAD
CAMERON CREEK COUNTY ROAD
DETOUR SIGN
CULTIVATED FIELD
Vertical Datum Based on Interpolation To USGS 7½ Quadrangle - SE SAWBAR HILLS, MT. Topography Prepared From Ground Survey Conducted April 3, 1987 By Spectrum Engineering Using A Plane Table And Alidade. This Topography Is Of Reconnaissance Class And Has Not Been Field Checked
N
SCALE IN FEET

SUBSURFACE RECLAMATION ESTIMATED QUANTITIES

WORK DESCRIPTION	AREA 1	AREA 2
TRAFFIC CONTROL SETUP	1 EACH	1 EACH
BOREHOLE DRILLING, 4-3/4" DIA (24-45 holes)	525 L.F. MAX	1290 L.F. MAX
BOREHOLE REAMING, 8" DIA (16 holes)	*250 L.F.	*390 L.F.
CASING PIPE, 6" I.D.	*250 L.F.	*390 L.F.
PROVIDING &/OR STOCKPILING BACKFILL MAT'L.	45 TONS	50 TONS
UNDERGROUND MINE STOWING	45 TONS	50 TONS
GRAVITY GROUT INJECTION, SETUP	6 EA	8-10 EA
GRAVITY GROUT INJECTION, GROUTING	*15 C.Y.	*15 C.Y.
PRESSURE GROUT INJECTION, SETUP	*3 EA	1 EA
PRESSURE GROUT INJECTION, GROUTING	*110 C.Y.	*120 C.Y.
BACKFILL BOREHOLE NOT INTO VOID (MAX.)	14 EA	29 EA
BACKFILL BOREHOLE INTO VOID (INCLUDES PIPE STAND)	1 EA	1 EA
CAMERON CREEK ROAD RESTORATION	85 L.F.	100 L.F.
WATER REMOVAL & DISPOSAL	15 KGAL	23 KGAL
BACKFILL DARRELL ADIT TRENCH	150 C.Y.	

BOREHOLE DATA

HOLE NO.	NO. OF HOLES	LENGTH OF BOREHOLE	BOREHOLE DIAMETER	WORK AREA	MINIMUM FOOTAGE	MAXIMUM FOOTAGE
*1	3-7	38'	3 @ 8"	1	114	266
*2	3	36'	3 @ 8"	1	108	108
*3	1	35'	8"	1	35	35
*4	1	31'	4⅝"	1	31	31
*5	1	27'	4⅝"	1	27	27
*6	1	19'	4⅝"	1	19	19
*7	1 Camera	39'	4⅝"	1	39	39
*8	3-12	43'	1 @ 8"	2	129	516
*9	4-8	41'	4 @ 8"	2	164	328
*10	4-8	45'	4 @ 8"	2	180	360
*11	1	41'	4⅝"	2	41	41
*12	1 Camera	45'	4⅝"	2	45	45
Area 1	11-15			TOTAL 1	373	525
Area 2	13-30			TOTAL 2	559	1290

WORK DESCRIPTION

ALL TRAFFIC WILL BE DETOURED WITH THE PROPER WARNING SIGNS AND ROUTE MARKERS BEFORE THE PROJECT BEGINS. BOREHOLES WILL BE DRILLED IN WORK AREA 1 TO DETERMINE THE SIZE AND LOCATION OF THE MINE INCLINE. BOREHOLES WILL BE DRILLED IN WORK AREA 2 TO DETERMINE THE SIZE AND LOCATION OF MINE WORKINGS SUSPECTED TO RUN UNDER THE COUNTY ROAD. SELECTED BOREHOLES WILL BE REAMED AND CASING INSTALLED TO FACILITATE STOWING & GROUTING OPERATIONS. BARRIERS WILL BE CONSTRUCTED WITH GRAVEL IN THE MINE VOID 8 FEET EAST OF THE COUNTY ROAD AT WORK AREA 1. GROUT WILL THEN BE INJECTED TO FILL THE CAVITY UNDERLYING THE COUNTY ROAD. WATER WILL BE PUMPED OUT OF THE CAVITY DURING GROUTING OPERATIONS. THE WATER WILL BE DISPOSED AT AN APPROVED SITE. THE GROUTING PROCESS WILL BE MONITORED WITH A DOWNHOLE CAMERA SUPPLIED BY THE OWNER. THE SAME PROCEDURE OUTLINED ABOVE WILL TAKE PLACE AT WORK AREA 2 IF A CAVITY IS FOUND UNDER THE COUNTY ROAD. ALL DEBRIS IN THE ADIT TRENCH AND SP5 WILL BE REMOVED AND DISPOSED OF AT AN APPROVED SITE. TOPSOIL WILL BE SALVAGED AND STOCKPILED FROM THE TRENCH IN FRONT OF THE ADIT OPENING. COAL SLACK WILL BE USED TO BACKFILL THE TRENCH. TOPSOIL WILL BE REPLACED ON TOP. ALL BOREHOLES WILL BE BACKFILLED AND THE COUNTY ROAD RESTORED TO IT'S ORIGINAL CONDITION. A DETAILED WORK DESCRIPTION IS LOCATED IN THE SPECIAL PROVISIONS.

DARRELL ADIT BOREHOLE DETAIL

SCALE 1" = 20'

LEGEND

- 4300 — CONTOUR
- P — PICTURE NUMBER AND ORIENTATION
- TRAFFIC DETOUR ROAD
- COUNTY ROAD
- DRAINAGE
- OPEN ADIT
- SP 3 / 9.5 — SUBSIDENCE PIT (SP) NUMBER (& DEPTH)
- CAVED SHAFT
- COAL SLACK PILE
- BOREHOLE

NOTICE

AN ABANDONED COAL MINE UNDERLIES THIS SITE. MANY POTENTIAL HAZARDS EXIST. THE EXTENT OF THESE HAZARDS IS NOT FULLY KNOWN. CONTRACTORS AND OTHER PERSONS WORKING AT THE SITE SHALL APPRISE THEMSELVES OF THE CONDITIONS AND TAKE WHATEVER STEPS ARE DEEMED NECESSARY TO INSURE SAFETY WHILE PERFORMING THEIR DUTIES.

STATE LOCATION MAP

VICINITY ACCESS MAP

SITE LOCATION MAP

SITE PLAN AND GENERAL LAYOUT

CAMERON CREEK EMERGENCY SITE

SECTIONS 22 & 23, T10N, R21E
GOLDEN VALLEY COUNTY, MONTANA

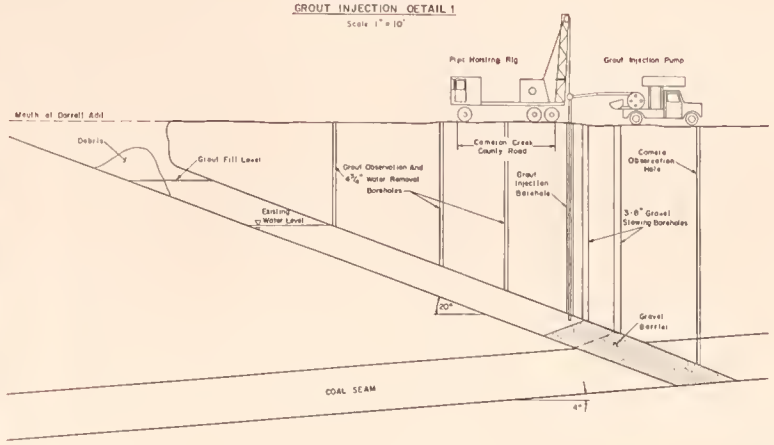
STATE OF MONTANA
DEPARTMENT OF STATE LANDS
ABANDONED MINE RECLAMATION BUREAU, RECLAMATION DIVISION

DATE: June 1987	SPECTRUM ENGINEERING
DRAWN BY: DLO	Mining and Civil Engineers
CHECKED BY:	5308 4th AVE NORTH
APPROVED BY:	BILLINGS, MONTANA

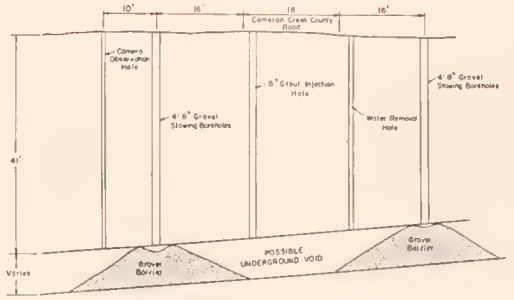
NO.	REVISION DATE	BY
1	9 15 87	DLO

SHEET NO. 1 of 2

DARRELL ADIT
GROUT INJECTION DETAIL 1
Scale 1" = 10'



AIR SHAFT 1
GROUT INJECTION DETAIL 2
Scale 1" = 10'



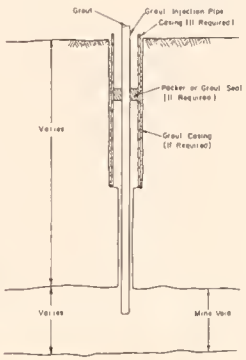
AERIAL PHO[illegible] THE CAMERON CREEK EMERGENCY SITE

LANDOWNER - SECTION 22 & 23
LEWIS RANCH, INC
LAVINA, MT 59046
CONTACT: EDGAR LEWIS
PHONE (406) 575-4447

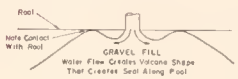
ENGINEER
SPECTRUM ENGINEERING
3302 FOURTH AVE NORTH
BILLINGS, MT 59101
CONTACT: BILL MAEHL
PHONE (406) 259-2412

DEPARTMENT OF STATE LANDS
ABANDONED MINE RECLAMATION BUREAU
RECLAMATION DIVISION
1625 ELEVENTH AVENUE
HELENA, MT 59620
CONTACT: MICHAEL HIEL
PHONE (406) 444-2074

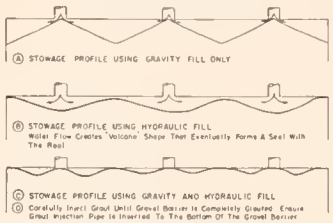
GROUT INJECTION BOREHOLE SCHEMATIC
No Scale



CROSS SECTION SCHEMATIC ALONG MINE OPENING



GRAVEL BARRIER SCHEMATIC CROSS SECTION ACROSS OPENING

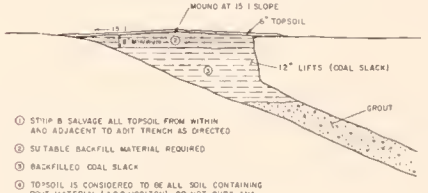


(A) STOWAGE PROFILE USING GRAVITY FILL ONLY

(B) STOWAGE PROFILE USING HYDRAULIC FILL
Water Flow Creates Volcano Shape That Eventually Forms A Seal With The Roof

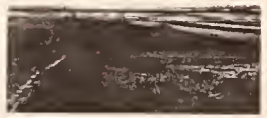
(C) STOWAGE PROFILE USING GRAVITY AND HYDRAULIC FILL
(D) Carefully Inject Grout Until Gravel Barrier Is Completely Grouted. Ensure Grout Injection Pipe Is Inserted To The Bottom Of The Gravel Barrier

DARRELL MINE OPENING BACKFILL DETAIL 3
Scale 1" = 10'

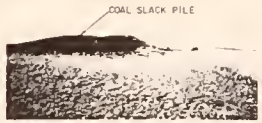


① STRIP & SALVAGE ALL TOPSOIL FROM WITHIN AND ADJACENT TO ADIT TRENCH AS DIRECTED
② SUITABLE BACKFILL MATERIAL REQUIRED
③ BACKFILLED COAL SLACK
④ TOPSOIL IS CONSIDERED TO BE ALL SOIL CONTAINING POST MATERIAL (A & B HORIZON) DO NOT BURY ANY TOPSOIL

① [illegible] AIR SHAFT [illegible] CAMERON CREEK [illegible]



② PICTURE 2 SHOWS THE CAMERON CREEK ROAD LEADING SOUTH ACROSS THE PROJECT SITE

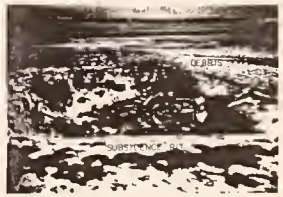


③ PICTURE 3 SHOWS THE COAL SLACK PILE TO BE USED TO BACKFILL THE DARRELL ADIT

④ PICTURE [illegible] WITH [illegible] CAMERON [illegible] THE [illegible]

⑤ PICTURE 5 SHOWS DEBRIS IN THE MOUTH OF THE DARRELL ADIT

⑥ PICTURE 6 IS A CLOSEUR OF THE DEBRIS IN THE MOUTH OF THE DARRELL ADIT WHICH IS TO BE REMOVED



⑦ PICTURE 7 SHOWS THE DEBRIS IN SUBSIDENCE PIT 5 WHICH IS TO BE REMOVED.

NOTICE

AN ABANDONED COAL MINE UNDERLIES THIS SITE. MANY POTENTIAL HAZARDS EXIST. THE EXTENT OF THESE HAZARDS IS NOT FULLY KNOWN. CONTRACTORS AND OTHER PERSONS WORKING AT THE SITE SHALL APPRISE THEMSELVES OF THE CONDITIONS AND TAKE WHATEVER STEPS ARE DEEMED NECESSARY TO INSURE SAFETY WHILE PERFORMING THEIR DUTIES.

SITE PLAN AND GENERAL LAYOUT

CAMERON CREEK EMERGENCY SITE
SECTIONS 22 & 23, T10N, R21E
GOLDEN VALLEY COUNTY, MONTANA

STATE OF MONTANA
DEPARTMENT OF STATE LANDS
ABANDONED MINE RECLAMATION BUREAU, RECLAMATION DIVISION

DATE	June 1987
DRAWN BY	OLD
CHECKED BY	MCM
APPROVED BY	

NO	REVISIONS	BY
1	6-15-87	OLD

SPECTRUM ENGINEERING
Mining and Civil Engineers
3302 4th AVE NORTH
BILLINGS, MONTANA

SHEET NO 2 of 2

B. Chronological History

1. Contractors with previous experience in grouting were contacted and ask to submit a bid based upon the bid package and pre-bid meeting. The following contractors were contacted:

Quality Concrete	Billings, Montana
Eby Mine Services	Brighton, Colorado
Renco	Belt, Montana
Ingram-Clevenger	Helena, Montana
Shumaker Trucking & Excavating	Great Falls, Montana
Mining Corporation	Lakewood, Colorado

2. The pre-bid conference was held at the site on June 22, 1987. Quality Concrete, Renco, Shumaker Trucking & Excavating, Mining Corporation, and Gordon Drilling were present. Don Sutton from Spectrum Engineering and Mike Hiel from the AMR Bureau conducted the pre-bid meeting.

3. Bids were opened on June 26, 1987. Bids were received from Quality Concrete, Renco, Shumaker Trucking and Mining Corporation with Shumaker submitting the low bid.

4. The agreement was signed and the contract awarded on June 30, 1987 to:

SHUMAKER TRUCKING AND EXCAVATING CONTRACTORS INC.
P.O. Box 1442
Great Falls, Montana 59403
Phone: 406/727-3537

5. The pre-construction meeting was held the first day of construction on July 8, 1987.

6. The contract time of 30 days started on July 6, 1987 per the Notice To Proceed.

7. All work, with the exception of revegetation work, was completed on July 15, 1987.

8. Revegetation work was completed on November 23, 1987 by the landowner, Edgar Lewis.

C. Equipment

1. Hough front end loader
2. Drill rig
3. Grout pump
4. Cement trucks

D. Daily Construction Log

Ken Karstad was designated as the Contractor's on-site superintendent. Hininger Drilling Company was the drilling subcontractor. Mr. Edgar Lewis, the landowner, did the seeding, fertilizing and mulching. The construction of this site proceeded as follows:

July 8, 1987

- Drilled hole 26. Hole void from 40 to 45 feet depth. Reamed 20 feet down to 10" diameter and destroyed the bit, then reamed the remaining 20 feet to 7".
- Drilled hole 27. Same void location as hole 26. Located 2 feet south of 26. Reamed to 7".
- Drilled hole 25. No void, hit 10 feet of coal.
- Drilled hole 28. Void from 41 to 46 feet. Possible side of wall. Reamed to 7".
- Drilled hole 29 south of hole 28. Void at 41 to 45 feet.
- All drill holes to this point have hit coal at approximately 37 feet.
- Drilled hole 30 four feet south of hole 29. Void at 40 to 45 feet.
- Remove debris from adit and subsidence area with front end loader with clam shell bucket.
- Topsoil (45 cubic yards) and subsoil (45 cubic yards) removal from adit at Site 1.
- Drilled hole 31. Possible edge of entry. Solid but lost circulation.
- Drilled hole 32. Void from 40 to 44 feet.
- Drilled hole 33. Void from 40 to 46 feet.

July 9, 1987

- Drilled hole 34. Hit side of entry.
- Drilled hole 35. Left as water well for landowner.
- Drilled hole 1 at Area 2 on west side of road. Coal at 37 to 47 feet. No void.
- Drilled hole 2 at Area 2. Coal 37 to 48 feet.
- Drilled hole 3 at Area 2. Coal 37 to 47 feet wet but no void.
- Drilled hole 4. Coal from 36 to 39 feet grading to shale.
- Drilled hole 5. Coal 37 to 47 feet with bottom wet.
- Drilled hole 6. Coal 37 to 47 feet with bottom dry. Mike Hiel and I decide to stop drilling Area 2.

July 10, 1987

- Install gravel barrier.
- Washed gravel with drill using angle device.
- Set 45 feet of casing in water well for landowner.

D. Daily Construction Log (Cont.)

July 12, 1987 - Drilling the grout and observation holes.

July 13, 1987 - Poured grout into gravel barrier, 15 yds.

July 14, 1987 - Injected 16 truck loads of grout down boreholes, 116 cubic yards. The grout slump angle was about 45 degrees.

July 15, 1987
- Backfilled adit trench. The coal slack was full of clay and compacted very well.
- Buried non-biodegradable debris in adit trench.
- Cleaned up cement and other mess and spread remaining gravel on the road.
- Project complete until revegetation.

November 23, 1987 - Revegetation completed by the landowner, Edgar Lewis. A total of 14.1 pounds of pure live seed was used, 31.8 pounds of fertilizer nutrients and 600 pounds of mulch.

III SLIDES

The description of the slides taken to document the work performed is found in Appendix A. In addition, the original slides are found at the very back of one volume and black and white copies of the slides are found in all three volumes directly behind the slide descriptions in Appendix A.

Two prints showing one view of the reclamation work and one county road sign are found on the following page.

AMR Bureau staff member, Mike Hiel, helping with the clean-up of the drill cuttings.

Abandoned Mine Land projects are completed in the most dangerous of surroundings as demonstrated by the road sign found on the way to the project area.

IV. COST SUMMARY

A. Final Payment Request

A copy of the one and only Contractor's Payment Request and a letter summarizing payment to the landowner for the revegetation work is contained in Appendix B.

B. Project Cost Summary

Site	Disturbed Acres	Cost/Acre	Total Project Cost
CAMERON CREEK EMERGENCY	0.3	$ 133,984.88	$ 40,195.46

C. Project Cost Breakdown

Item	Quantity	Cost per Unit	Cost per Acre	Total Cost
Mobilization	1 L.S.	4,500.00	15,000.00	4,500.00
Traffic Control	1 L.S.	1,250.00	4,166.67	1,250.00
4 3/4 boreholes	1194 Ft.	4.50	17,910.00	5,373.00
Borehole reaming	816 Ft.	8.50	23,120.00	6,936.00
6" I.D. casing	400 Ft.	6.50	8,666.67	2,600.00
Screened Gravel	54.26 Tons	16.75	3,029.53	908.86
Stow Gravel	54.26 Tons	10.00	1,808.67	542.60
Pressure Grout Set up	3 Each	175.00	1,750.00	525.00
Pressure Grouting	77.1 CuYd	95.00	24,415.00	7,324.50
Gravity Grout Set up	15 Each	175.00	8,750.00	2,625.00
Gravity Grouting	44 CuYd	87.125	12,778.33	3,833.50
Water removal/disposal	1 L.S.	380.00	1,266.67	380.00
Backfill holes not in voids	29 Each	65.00	6,283.33	1,885.00
Debris cleanup	2 Each	100.00	666.67	200.00
Salvage/Replace topsoil	90 CuYd	0.89	266.67	80.00
Close Mine Openings	1 L.S.	200.00	666.67	200.00
Road Restoration	1 L.S.	370.00	1,233.33	370.00
SCHUMAKER SUBTOTAL			131,778.21	39,533.46
Seeding and Fertilizing	1 L.S.	500.00	1,667.67	500.00
Mulch	600 Lb.	0.25	500.00	150.00
LANDOWNER SUBTOTAL			2,166.67	650.00
SPECTRUM FERTILIZER COST	31.8 Lb.	0.38	40.00	12.00
CAMERON CREEK TOTAL			133,984.88	40,195.46

V. SUMMARY

A. Completed Reclamation

The contract allowed the general Contractor 30 calendar days to complete the project site. He worked 7 days or 23.3% of the contract time. The seed and fertilizer was taken to the landowner on November 14th and the revegetation was completed on November 23rd.

B. Comments

Subsidence features on both sides of the road indicated that additional mine workings may have passed under the road to the north of the adit. Drilling on 10 feet centers did not encounter any mine openings, and since the coal seam was 40 feet beneath the surface and the roof consisted of competent sandstone, a decision was made by Mike Hiel and Don Sutton not to pursue this any further.

Drill cuttings indicated that the coal seam was deteriorating to coaly carbonaceous shale, so the workings, if even present, probably consisted of only narrow exploration drifts.

C. Recommendations

The grouting was started on the downhill side of the decline adit and forced uphill until it came out the mouth of the adit. This procedure should have permanently eliminated the site hazard. No monitoring should be required.

Monty Hininger, the driller, had developed a method of spreading the gravel to ensure that a total barrier was achieved. A section of pipe which had been welded shut on the bottom had a 90 degree open elbow coming off of it near the bottom of the pipe. This was attached to the drill string, placed into the gravel and rotated with a small amount of air pressure. This rotating "air hose" forced the gravel outward thus spreading it exactly where we wanted it. This allowed us to completely fill the adit's width and height with gravel. This system should be considered any time a gravel barrier is installed.

The grout (sand and cement) mixture used could probably have been replaced with a concrete mix (gravel and cement) that would have worked just as well. This would have reduced the project cost.

A grout or concrete mix with a high slump angle probably could have been used to build the barrier in place of the gravel which would have required fewer drill holes. For future jobs where fill is required to stabilize a road, pumping high slump grout or concrete from the middle and edges of the roadway should be considered.

APPENDIX A

SLIDE DESCRIPTIONS

CAMERON CREEK EMERGENCY BACKFILL
SLIDE DESCRIPTION

ASSIGNED NUMBER	DATE TAKEN	SLIDE NUMBER	SUBJECT OR COMMENTS
1	7-08-87	1	Mouth of decline adit.
2	7-08-87	2	Mouth of adit dips 20 degrees under road.
3	7-08-87	3	Removing fence wire from adit.
4	7-08-87	4	Removing fence wire from adit.
5	7-08-87	5	Debris clean-up from adit entrance.
6	7-08-87	6	Front end loader on lowboy.
7	7-08-87	7	Debris clean-up from sinkhole.
8	7-08-87	8	Debris clean-up from sinkhole.
9	7-08-87	9	Hininger's drill rig.
10	7-08-87	10	Drilling holes for gravel barrier on 2 foot spacing.
11	7-08-87	11	Hininger's drill rig.
12	7-08-87	12	7 inch reamer bit.
13	7-08-87	13	Removing reamer bit.
14	7-08-87	14	7 inch reamer bit.
15	7-08-87	15	Slack pile in front of adit entrance.
16	7-08-87	16	Salvaging topsoil from adit entrance.
17	7-08-87	17	Salvaging topsoil from adit entrance.
18	7-08-87	18	Logging truck ignoring weight limit signs. Drill is working on gravel stowing holes.
19	7-08-87	20	View from adit mouth to gravel storage holes.
20	7-08-87	21	Removing debris from sinkhole.
21	7-08-87	22	Removing debris from sinkhole.
22	7-08-87	23	Removing debris from sinkhole.

CAMERON CREEK EMERGENCY BACKFILL
SLIDE DESCRIPTION

ASSIGNED NUMBER	DATE TAKEN	SLIDE NUMBER	SUBJECT OR COMMENTS
23	7-08-87	24	Removing debris from sinkhole.
24	7-08-87	26	Debris from sinkhole.
25	7-08-87	27	Hininger's drill rig and Shumaker's front end loader.
26	7-09-87	29	Unloading grout pump from lowboy using front end loader.
27	7-09-87	30	Drilling water well.
28	7-09-87	31	Collecting drill cuttings in front end loader bucket.
29	7-09-87	33	Clean-up drill cuttings.
30	7-09-87	34	Clean-up drill cuttings.
31	7-09-87	35	Site 2 - drilled row of holes looking for void.
32	7-09-87	36	Drilling gravel stowage holes.
33	7-09-87	37	Topsoil salvaged from adit mouth.
34	7-09-87	38	Lewis Ranch looking west from the site.
35	7-09-87	3	Drilling.
36	7-09-87	4	Setting 6" P.V.C. casing.
37	7-09-87	6	Setting 6" P.V.C. casing.
38	7-09-87	7	Setting casing in gravel stowage holes.
39	7-09-87	8	Setting casing in gravel stowage holes.
40	7-10-87	9	Stowing gravel.
41	7-10-87	10	Shoveling gravel into cased holes.
42	7-10-87	13	Stowing gravel.
43	7-10-87	14	Placing pump in adit.
44	7-10-87	17	Pump in place in adit

CAMERON CREEK EMERGENCY BACKFILL
SLIDE DESCRIPTION

ASSIGNED NUMBER	DATE TAKEN	SLIDE NUMBER	SUBJECT OR COMMENTS
45	7-10-87	16	Burning debris.
46	7-13-87	18	Pouring grout into gravel stowage holes.
47	7-13-87	20	Pouring grout into front of gravel barrier.
48	7-13-87	21	First load of grout into gravel barrier.
49	7-14-87	2	Pouring grout into gravel.
50	7-14-87	3	Front end loader regrading borrow area.
51	7-14-87	4	Pouring grout into gravel.
52	7-14-87	5	Cleaning cement truck into adit mouth.
53	7-14-87	27	Cleaning cement truck into adit mouth.
54	7-14-87	6	Lifting pipe from hole with front end loader.
55	7-14-87	7	Preparing to lift pipe from hole with front end loader bucket and chain.
56	7-14-87	8	Grout from truck to pump and down the hole.
57	7-14-87	10	Grout from truck to pump.
58	7-14-87	13	Looking down on cement pump from the cement truck.
59	7-14-87	14	Cement truck and grout pump.
60	7-14-87	15	Cement flowing into mouth of grout pump.
61	7-14-87	16	Pouring grout into mouth of grout pump.
62	7-14-87	17	Grout injection system.
63	7-14-87	18	S&K Trucking from Roundup supplied the grout.
64	7-14-87	19	The Contractor - Shumaker Trucking.
65	7-14-87	20	Grout injection system.
66	7-14-87	21	Grout pump.

CAMERON CREEK EMERGENCY BACKFILL
SLIDE DESCRIPTION

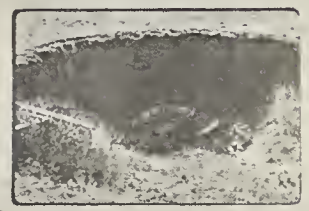
ASSIGNED NUMBER	DATE TAKEN	SLIDE NUMBER	SUBJECT OR COMMENTS
67	7-14-87	22	Setting water pump in adit trench.
68	7-14-87	23	Mouth of grout pump.
69	7-14-87	24	Water coming up adit mouth.
70	7-14-87	25	Pulling pump out of adit.
71	7-14-87	26	Illustration of grout slump angle.
72	7-14-87	29	Pulling pipe from hole with front end loader.
73	7-14-87	30	Last load of grout into adit mouth.
74	7-14-87	31	Final wash-up in adit trench.
75	7-14-87	32	Final load and wash-up.
76	7-15-87	2	Golden Valley County road sign.
77	7-15-87	3	Final clean-up.
78	7-15-87	4	Final clean-up.
79	7-15-87	5	Topsoil, overburden and coal slack piles.
80	7-15-87	6	Mouth of adit full of grout.
81	7-15-87	7	Adit mouth after completing the grouting.
82	7-15-87	8	Suitable overburden and topsoil piles.
83	7-15-87	9	Looking down 6 inch P.V.C. casing.
84	7-15-87	10	Construction sign.
85	7-15-87	11	Debris pile after burning.
86	7-15-87	12	Area 2 - grout around plugged drill holes.
87	7-15-87	13	Final clean-up. One hole was left as water well for Edgar Lewis, the landowner, at his request.
88	7-15-87	15	Filling adit with front end loader.

CAMERON CREEK EMERGENCY BACKFILL
SLIDE DESCRIPTION

ASSIGNED NUMBER	DATE TAKEN	SLIDE NUMBER	SUBJECT OR COMMENTS
89	7-15-87	20	Backfilling adit with front end loader.
90	7-15-87	19	Salvaged topsoil and overburden stockpiles.
91	7-15-87	21	Knocking down top of adit for proper compaction.
92	7-15-87	24	Backfilling adit with front end loader.
93	7-15-87	25	Compacting backfill.
94	7-15-87	26	Backfilling adit.
95	7-15-87	27	Logging truck traffic on Cameron Creek Rd.
96	7-15-87	28	Coal slack placed into adit mouth.
97	7-15-87	29	Adit backfilling nearly complete.
98	7-15-87	30	Adit trench backfilled and ready to topsoil.
99	7-15-87	31	Moving topsoil pile.
100	7-15-87	32	Spreading topsoil with front end loader.
101	7-15-87	33	Site complete and ready for revegetation.
102	7-15-87	34	Coal slack to be cleaned up with adjacent sites.
103	7-15-87	28	Sign of the times on the road to the project site.

Mouth of Decline/Adit

7-8-87



(1) CAMERON CREEK

Mouth of Adit. Dips about 20° under road. 7/8/87

(2) CAMERON CRK.

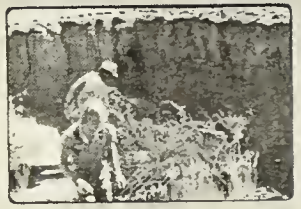
Pulling fence wire from Adit 7/8/87

(3) CAMERON CRK.

Pulling wire from Adit 7/8/87

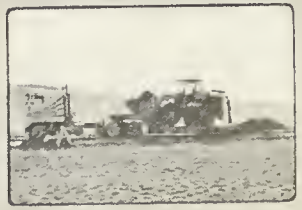
(4) CAMERON CRK.

CLEANING DEBRIS FROM ADIT MOUTH SO WE CAN GET IN WITH PUMP



(5) CAMERON CRK 7-8-87

HOUGH ARRIVING ON LOW BOW July 8, 1987



(6) CAMERON CRK 7-8-87

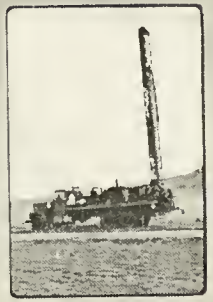
CLEANING DEBRIS FROM SINK HOLE July 8 1987

(7) CAMERON CRK

CLEANING DEBRIS FROM ADIT July 8 1987

(8) CAMERON CRK

Hiningers Drill



(9) Cameron Cr. 7/87

Drilling holes for gravel barrier. Hole spacing indicated by stakes - 2'

(10) CAMERON CRK 7-8-87

Cameron Creek 7/87

Drill Rig

(11)

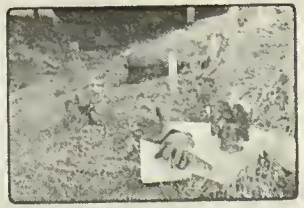
7" Reamer. Bit

(12) CAMERON CRK 7-8-87

Monty is removing Reamer, July 8 1987

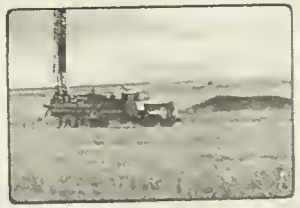
(13) Cameron CRK

7" Reamer Bit



(14) Cameron Cr 7-8-87

Cameron Creek - Slack pile in background.



(15) 7-8-87

Salvaging topsoil from adit Mouth July 8 1987

(16) Cameron Cr.

Salvaging topsoil from Adit Mouth

(17) Cameron Cr. 7-8-87

Note the logging truck ignoring our weight limit signs. Cameron Cr 7-8-87

(18) Drill is working on gravel stowage holes

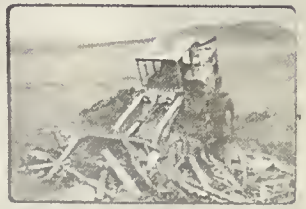
Looking from adit mouth towards gravel stowage holes

(19) Cameron Cr 7-8-87

Cleaning debris from Sink Hole

(20) Cameron Cr. 7-8-87

Cleaning up debris July 8 1987



(21) Cameron Cr.

CLEANING DEBRIS OUT OF SINK HOLE

(22) Cameron Cr. 7-8-87

CLEANING DEBRIS OUT OF SINK HOLE

(23) Cameron Cr. 7-8-87

RANCH DEBRIS IN SINK HOLE July 8 1987

(24) Cameron Cr.

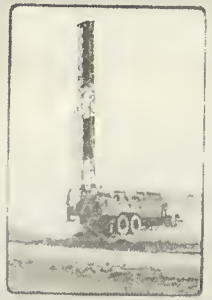
CAMERON CREEK SITE 7/8
Heninger Drill Rig
Schumaker FEL

(25)

Lifting grout pump from low boy 7/9/87

(26) Cameron Cr.

Drilling hole 7/9/87



(27) Cameron Cr.

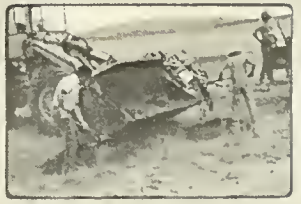
Mike Hiel shoveling drill cuttings into bucket 7/9/87

(28) Cameron Cr

Cleaning up drill cuttings

(29) Cameron Cr. 7-9-87

Cleaning up drill cuttings 7/9/87



(30) Cameron Cr.

Cameron Creek - Site 2
Drilled row of holes unsuccessfully looking for void.

(31) July 9 1987

Drilling gravel stowage Holes July 9 1987

(32) Cameron Cr.

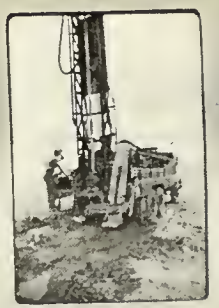
Topsoil salvaged from Adit Mouth 7/9/87

(33) Cameron Cr.

LEWIS RANCH
July 9 1987
looking west

(34) Cameron Cr.

Drilling July 9,



(35) Cameron Cr.

Setting 6" ø PVC Casing

(36) July 9-87
Cameron Cr.

Setting Casing

(37) Cameron Cr.
7-9-87

Setting Casing for gravel stowage holes

(38) Cameron Cr
7-9-87

Setting Casing in gravel stowage holes

(39) Cameron Cr.
7-9-87

Stowing gravel
July 10. 1987

(40) Cameron Cr.

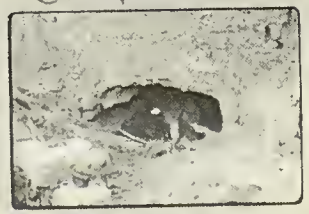
Shoveling gravel into cased holes.

(41) Cameron Cr.
7-10-87

Stowing gravel

(42) Cameron Cr.
7-10-87

Placing pump in adit
July 10 1987



(43) Cameron Cr.

Pump in place in Adit.

(44) Cameron Cr.
7-10-87

Burning debris
July 10 1987

(45) Cameron Cr.

Pouring grout into gravel storage holes

(46) Cameron A.
7-10-87

Pouring grout into front gravel barrier

(47) Cameron A.
7-13-87

First load of grout into gravel barrier

(48) Cameron A.
7-13-87

Pouring grout into gravel

(49) CAMERON CRK.
7-14-87

F.E.L. REGRADING BORROW AREA.

(50) CAMERON CRK.
7-14-87

Pouring grout into gravel

(51) CAMERON CRK
7-14-87

Cleaning cement truck into adit mouth

(52) CAMERON CRK
7-14-87

Cleaning cement truck into adit. Note water level

July 14 1987

(53) CAMERON CRK.

F.E.L was used to lift pipe out of hole

(54) CAMERON CRK.
7-14-87

Preparing to left pipe with bucket-chain

(55) CAMERON CRK
7-14-87

rout is being dumped into ump and pumped down t, a hole

(56) 14 87
CAMERON CRK

Transfering grout from cement truck to grout pump 7-14-87

(57) CAMERON CRK

From Cement truck looking down on cement pump

(58) 14, 1987
CAMERON CRK

Cement truck and grout/cement pump

(59) 14 1987
CAMERON CRK.

Cement flowing into mouth of grout pump

(60) CAMERON CRK
7-14-87

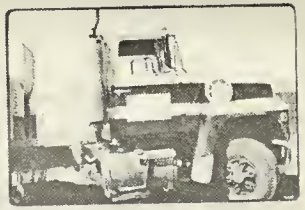
Pouring grout into concrete pump

(61) CAMERON CRK
7-14-87

Grout injection system

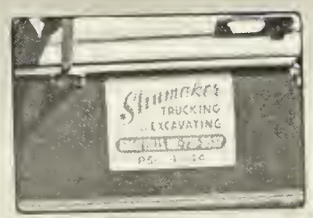
(62) CAMERON CRK
7-14-87

S & K Trucking from Roundup Supplied the grout.



(63) CAMERON CRK
7-14-87

The Contractor



(64) CAMERON CRK
7-14-87

Grout injection system

(65) CAMERON CRK
7-14-87

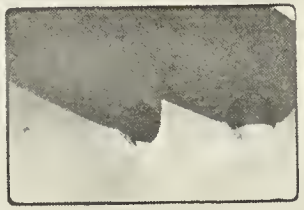
The grout pump

(66) CAMERON CRK
7-14-87

Setting water pump in adit mouth

(67) CAMERON CRK
7-14-87

Looking into mouth of grout pump.

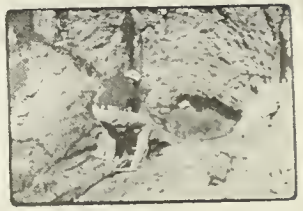


(68) CAMERON CRK.
7-14-87

Water coming up adit mouth
July 14, 1987

(69) CAMERON CRK.

Ken Carlstad pulling pump out of adit. Note water coming out of adit



(70) July 14
CAMERON CRK
7-14-87

Illustration of grout slump angle tool

(71)

finally worked. It must be sunny!

F.E.L is pulling pipe out of hole Note chain to bucket tooth.

(72) CAMERON CRK
7-14-87

Last load of grout went into adit mouth.

(73) CAMERON CRK
7-14-87

Final washup
July 14 1987

(74) CAMERON CRK
7-14-87

Final load & washup

(75) CAMERON CRK
7-14-87

CAMERON CREEK AML.

7-15-87

76

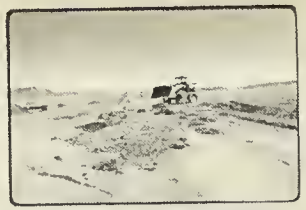
SITE, North of LAVINA

FINAL CLEANUP
July 15 1987

77 CAMERON CRK.

3

Final Clean Up
July 15 1987



78 CAMERON CRK.

4

Topsoil on right hand side
Suitable O.B. in middle
Coal Slack on left
7-15-87

79

T shaped gadget fits onto FEL bucket and is used like a crane
CAMERON CRK.

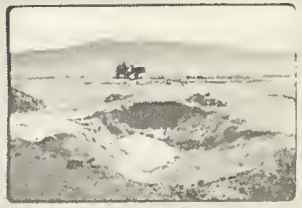
5

Mouth of Adit. Showing it full of grout.
Foreground is cement truck washings.

80 CAMERON CRK.
7-15-87

9

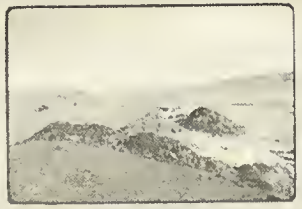
Adit mouth after grouting complete, but before reclamation



81 July 15, 1987
CAMERON CRK

7

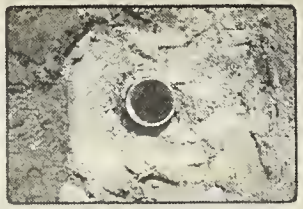
View from coal slack pile looking at suitable O.B and topsoil piles



82 CAMERON CRK.
7-15-87

8

Looking down 6" ⌀ PVC casing.



83 CAMERON CRK.
7-15-87

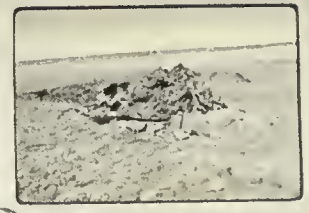
6

Construction Sign

84 CAMERON CRK.
7-15-87

10

Debris pile after it was burned.



85 CAMERON CRK.
7-15-87

11

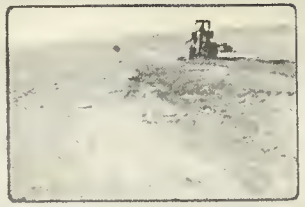
Area 2. Puddles of grout around plugged drill hole

86

Grout was cleaned up later. CAMERON CRK.
7-15-87

21

Final Clean-up in process. Water well left for E. Lewis



87 CAMERON CRK.
7-15-87

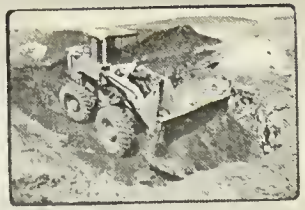
13

Filling Adit
July 15 1987

88 CAMERON CRK

15

Backfilling Adit
7/15/87



89 CAMERON CRK
7-15-87

20

Salvaging topsoil and suitable overburden

90 CAMERON CRK
7-15-87

31

Knocking down top of Adit so fill can be compacted properly

(91) CAMERON CRK 7-15-87

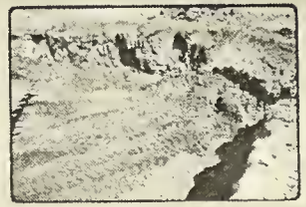
Backfilling Adit. Pulling down edges so it can be compacted

(92) CAMERON CRK 7-15-87

Loader is compacting backfill

(93) CAMERON CRK 7-15-87

Backfilling in process. Edges were knocked down to facilitate compacting.



(94) CAMERON CRK. 7-15-87

LOGGING TRUCK USING CAMERON CREEK RD

(95) CAMERON CRK 7-15-87

FEL "dozing" slack into adit mouth

(96) CAMERON CRK 7-15-87

Adit backfill nearly complete

(97) July 15 1987 CAMERON CRK

Adit trench backfilled ready for topsoiling.

(98) CAMERON CRK 7-15-87

Moving topsoil pile

July 15 1987

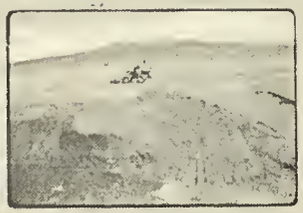
(99) CAMERON CRK,

Spreading topsoil

July 15, 1987

(100) CAMERON CRK.

Finished! Ready for revegetation

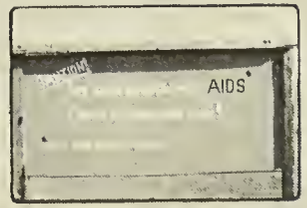


(101) CAMERON CRK 7-15-87

Finished. Coal slack will be cleaned up with other adjacent sites.

(102) CAMERON CRK 7-15-87

SIGN OF THE TIMES
NORTH OF LAVINA
JULY 9 1987



Cameron Cr. (103)

A P P E N D I X B

FINAL PAY REQUEST

Payment Request No. 1

RECEIVED
JUL 29 1987
STATE LANDS

From: July 8, 1987 To: July 15, 1987

Project Name: Cameron Creek Emergency

Location: Golden Valley, County Montana Project No.: Cameron Creek Emergency Backfill Contract

Name of Contractor: Shumaker Trucking Address: P.O. Box 1442
Great Falls, MT 59403

Summary Of Project Status

Amount of Original Contract	$	39,533.46
Amount of Approved Change Order(s)		0.00
TOTAL CONTRACT AMOUNT		39,533.46
Contract Time Used to Date		7 Days
Percentage of Contract Time Used		100 %
Percentage of Contract Amount Earned		100 %

Original Contract Amount Completed	39,533.46
Change Order(s) Amount Completed	0.00
Amount for Material On Site	0.00
TOTAL To Date	39,533.46
Times 90% = TOTAL AMOUNT Earned to Date	N/A
Less Previous Amount Earned	N/A
Amount Payable This Period	39,533.46
Less 1% Gross Receipts Tax	395.33
TOTAL DUE CONTRACTOR THIS PERIOD	39,138.13

Requested By: Shumaker Trucking _____ (Contractor) Date: 7-20-87

Checked By: Spectrum Engineering _____ (Engineer) Date: 7-21-87

Approved By: Department of State Lands S. McAnally (Owner) Date: 7/23/87
Abandoned Mine Reclamation Bureau

PAY REQUEST No.1
SPECTRUM ENGINEERING

PROJECT: CAMERON CREEK EMERGENCY BACKFILL — PAGE 2 of 2

ITEMIZATION OF QUANTITIES AND COSTS

ITEM NO.	DESCRIPTION	QUANTITY	UNIT PRICE	PAYMENT
1	MOBILIZATION	1 LS	$4,500.00	$4,500.00
2	TRAFFIC CONTROL	1 LS	$1,250.00	$1,250.00
3	DRILL 4-3/4" BOREHOLE	1194 FT	$4.50	$5,373.00
4	REAM BOREHOLES	816 FT	$8.50	$6,936.00
5	6" ID CASING	400 FT	$6.50	$2,600.00
6	PROVIDE GRAVEL	54.26 TON	$16.75	$908.86
7	STOW GRAVEL	54.26 TON	$10.00	$542.60
8	PRESSURE GROUT SETUP	3 EA	$175.00	$525.00
9	PRESSURE GROUT	77.1 YD	$95.00	$7,324.50
10	GRAVITY GROUT SETUP	15 EA	$175.00	$2,625.00
11	GRAVITY GROUT	44 YD	$87.13	$3,833.50
12	PUMP WATER	1 LS	$380.00	$380.00
13	BACKFILL BOREHOLES NOT IN VOID	29 LS	$65.00	$1,885.00
14	BACKFILL BOREHOLES INTO VOID	0 EA	$100.00	$0.00
15	DEBRIS CLEANUP	2 EA	$100.00	$200.00
16	SALVAGE/REPLACE TOPSOIL	1 LS	$80.00	$80.00
17	CLOSE MINE OPENING	1 EA	$200.00	$200.00
18	ROAD RESTORATION	1 EA	$370.00	$370.00
	TOTAL PAYMENT			$39,533.46

SPECTRUM ENGINEERING

January 6, 1988

Mr. Edgar Lewis
Lavina, Montana 59046

Dear Mr. Lewis:

Per our phone discussion today, I understand that you completed the final seeding, fertilizing and mulching of the Cameron Creek Emergency Project (T10N, R21E, Sections 22/23) on November 23, 1987. Based on our contract, enclosed is the $500 flat fee for revegetation plus $150 for the mulch (12 bales times 50 pounds/bale times $0.25/pound) for a total of $650.00.

We certainly appreciate your help in completing this project and look forward to working with you on the remainder of the abandoned mine sites later this year.

Sincerely,

Bill

WILLIAM C. MAEHL, P.E.
Project Supervisor

WCM/tmb

Enclosure

3302 4th Avenue North Billings, Montana 59101 406/259-2412 Telex 910-975-1610

A P P E N D I X C

ENGINEERING VERSUS

CONSTRUCTION COST ANALYSIS

CAMERON CREEK EMERGENCY BACKFILL
F I N A L R E P O R T

ANALYSIS OF PROFESSIONAL SERVICE FEES
DATE OF PREPARATION: JANUARY 25, 1988

PROFESSIONAL SERVICE	AMOUNT
o Data Gathering, Site Evaluation, Preliminary Engineering, Final Engineering, Bidding Documents	$ 17,286.91
o Construction Administration, Construction Inspection, Final Report Preparation	$ 8,067.98
SPECTRUM ENGINEERING COSTS	$ 25,354.89
CONSTRUCTION COSTS	$ 39,533.46
REVEGETATION COSTS	662.00
TOTAL CONSTRUCTION COSTS	$ 40,195.46

PERCENTAGE ANALYSIS	PERCENT
PRE-CONSTRUCTION SPECTRUM ENGINEERING COST COMPARED TO CONSTRUCTION COST	43.0 %
CONSTRUCTION & POST-CONSTRUCTION SPECTRUM ENGINEERING COST COMPARED TO CONSTRUCTION COST	20.1 %
TOTAL SPECTRUM ENGINEERING PROJECT COST COMPARED TO CONSTRUCTION COST	63.1 %

REMARKS: Services provided included landowner contact and consent, budget preparation, basic engineering design, bid document preparation, contract administration, quantity accounting and construction staking, and full time construction inspection.